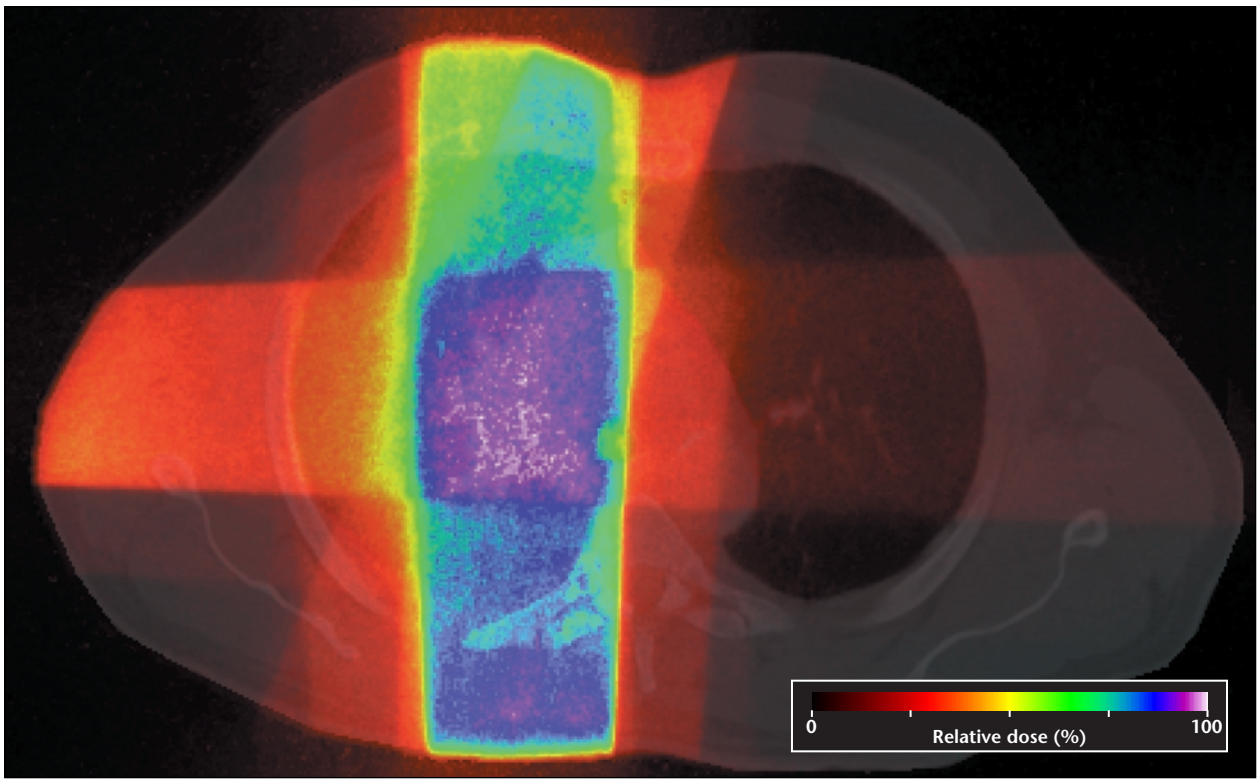
PEREGRINE: LUNG



Five-field treatment for a lung tumor; 6 MV photon beams.

Introduction

PEREGRINE is a 3D Monte Carlo dose calculation system designed specifically for radiation therapy. The main advantages of Monte Carlo dose calculations are their robustness for a wide range of beam modifiers and beam geometries and their inherent accuracy in the presence of three-dimensional surface irregularities, missing tissue, and tissue heterogeneities.

Current dose calculation methods approximate dose distributions in the patient based on dose distributions in water. PEREGRINE determines the dose in the patient by directly simulating particle transport through both the beam delivery system and patient.

Accuracy for Lung

External beam radiation therapy of lung tumors requires accurate dose calculations for a variety of field and patient characteristics. The measurement comparisons (on the reverse side) highlight PEREGRINE's accuracy for three dose-calculation conditions common to lung tumor treatments: depth dose comparisons for a variety of field sizes, a 2x8-cm central block, and a lung heterogeneity. Comparisons are made for 6- and 18-MV beams.Water phantom measurements were made at the University of California at San Francisco on a Varian 2100C 6-MV photon beam using a Scanditronix photon diode (0.45 mm thick, 2.5 mm diameter, p-type silicon detector) or a Wellhofer IC-10 air-equivalent ion chamber (6 mm outer diameter, 0.4 mm wall thickness, 3.3 mm active length). All water phantom measurements were made at a source-to-surface distance of 90 cm.

Measurements around the 8-cm lung heterogeneity (0.3 g/cm^3 lung-equivalent plastic, manufactured by Gammex RMI), located 3-cm below the surface of a water-equivalent plastic phantom were made at the Medical College of Virginia on a Varian 2100C 18-MV photon beam with 0.15-mm-thick TLD-100 LiF thermoluminescent dosimeters and a Markus ion chamber (Plexiglass cylindrical chamber with a collection volume of 6-mm in diameter, 2-mm in height). The lung-heterogeneity phantom was positioned at 100-cm source-to-surface distance.

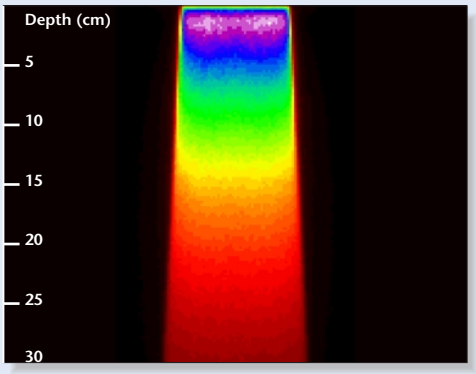
All measurements and calculations are reported in absolute dose per monitor unit. Ion chamber measurements have been corrected for effective chamber position, but not for position-dependent variation in the electron energy spectrum in the ion chamber cavity, which could affect the accuracy of measurements in the buildup region ($D < D_{max}$) and outside the beam penumbra.

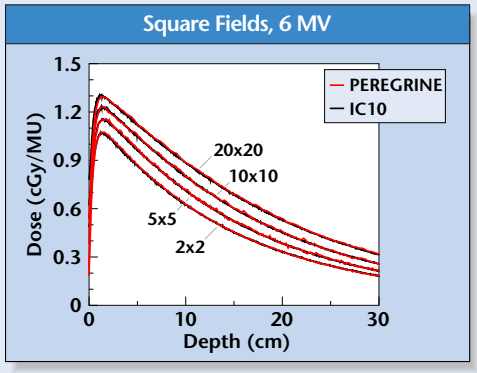
Results demonstrate PEREGRINE's acuracy for predicting absolute dose per monitor unit, dose at depth, dose distributions for blocked fields, and dose in regions of electronic non-equilibrium.

PEREGRINE

Dose at Depth

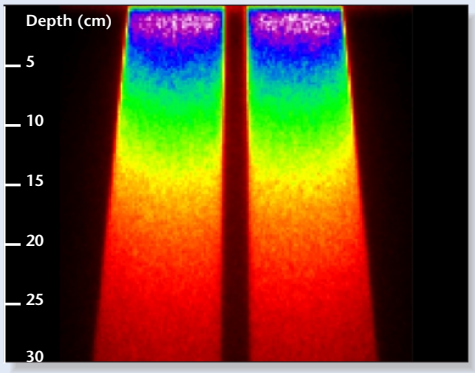
PEREGRINE uses first-principles physics to accurately predict dose for low energy photon beams

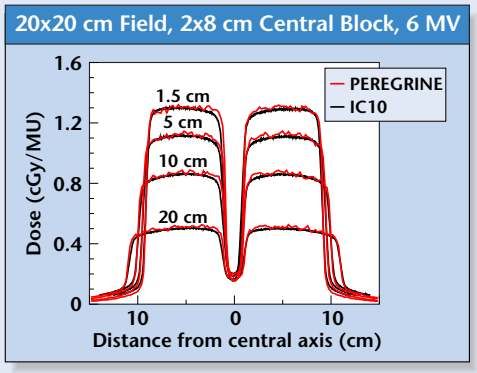




Central Beam Block

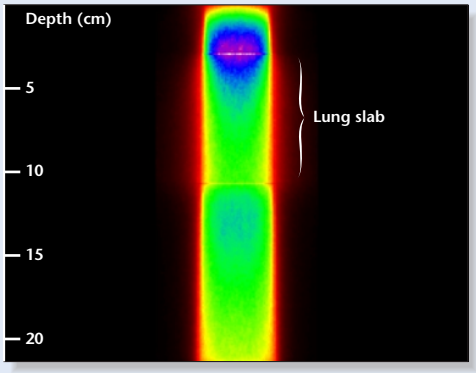
PEREGRINE accurately models the effects of all beam modifiers including central axis blocks

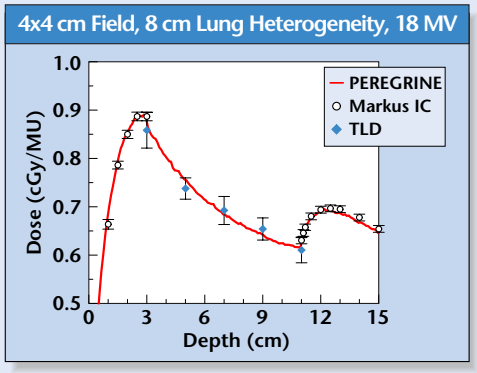




Lung Heterogeneity

PEREGRINE's Monte Carlo electron transport algorithms accurately model dose at the tumor-lung interface





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